

THE INDIVIDUALITY OF THE BEAN POD AS COMPARED WITH THAT OF THE BEAN PLANT

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This paper is a preliminary report on some experiments bearing on the question to what extent parts of a plant, apparently alike, may possess an individuality similar to that of individual plants.

It is a well-known fact that organs that are homologous may be differentiated from one another. For example, the first pair of leaves of the bean are, as a rule, simple, those following are compound. The foliage leaves of reproductive parts are commonly different in shape, size, and other characters from those of vegetative parts. In the composites the outer flowers of a head may be of quite a different type from the inner and often the fruits produced by them are morphologically distinct.

Many instances could be cited in which lateral organs have been found to differ from terminal organs in the number or shape of their parts. It will be sufficient here to mention the fact that the number of flowers in the inflorescences of Compositae and Umbelliferae, and the number of stamens and carpels and other floral parts in other forms, have been found to exhibit differences according to their position on the plant. Flowers have been found to differ in size, whether produced early or late in the season; as, for example, in tobacco, and in the composites it is a common observation that flower number of the heads decreases with the advance of the season.

Often, however, the differentiations are not of sufficient magnitude to be readily detected and we are then inclined to speak of variations. In such instances a detailed study frequently shows organs apparently alike to be different. The differences may be slight, but regular and significant. In other words, homologous parts may show individuality, comparable to the individuality shown by entire plants.

In the winter of 1915 an experiment bearing on this point was planned and the data recorded are from thirty-eight plants of the Longfellow variety of string-bean grown in the summer of 1916. The plants had 736 pods and 3,462 beans. The individuality of the bean pod and of the bean plant chosen for expression is the shape of the beans. An index, the thickness of the bean divided by the width measured from the hilum to the opposite side, has been used not because any particular importance is to be attached to this measure, but because it was convenient. An index of this sort is preferable to weight or to a single measurement as thickness or length because purely physiological differences due to nutrition are more probably eliminated. It was observed that the beans varied considerably in form, some being flat and others much thicker. This is expressed in the index, which varies from about 70 to about 110.

If all the pods on a plant were alike and the variations among the individual beans of a plant purely chance variations, the average index of each pod, assuming each pod to contain a large number of beans, would be the same as the average index for the plant as a whole. There would then be no variation among the pods or, in other words, they would all be alike. If, however, there are differences among the averages for the pods, the pods show individuality.

We have first to consider in how far the plants are alike or different. As we might expect, the average index is not the same for all plants. It ranges from 86 to 98, the average being 94 with a standard deviation of ± 3.4 . In other words, the plants are not all alike, but have individuality, some with thicker and others with flatter beans.

We may treat the separate pods on a plant in the same way. The fact that the pods contain a small number of beans and not all pods the same number must be taken into account in the calculation, in order that the results obtained may be comparable. If the variability of the individual beans on a plant is expressed by σ , the correlation between the beans in a pod by r , and the number of beans in a pod by n ; then s , the observed variability of the beans in a pod, is expressed by the following formula:

$$s^2 = \frac{n-1}{n} (1-r) \sigma^2$$

From this calculation the amount of correlation of the beans within a pod (r) has been determined to be $+0.29$.

It appears from this that the pods exhibit individuality just as the plants do. The individuality of the pods is of almost the same order as that of the plants, the average standard deviation for the beans within a pod being ± 4.3 and for the individual plants ± 3.4 .

These studies do not show what the individuality of the pods is due to, whether to purely chance physiological differences as differences in nutrition or to definite morphological differentiation according to position of the pod on the plant. As has been mentioned before, there are many instances in which differences between homologous organs have been correlated with morphological position or time of development. I believe that the morphological position of the pod bears some relation to its individuality. I cannot now present quantitative results, but the material studied so far shows that there are slight differences in the form of the beans of the lowest and uppermost branches.

A further question to be investigated is whether such morphological differences as discussed in this paper may be inherited. As far as I know, there has been no work that would either prove or disprove the inheritance of such differences. Correns made some attempt to grow offspring from ray- and disk-flowers of *Dimorphotheca pluvialis*, but his material was meager and the results inconclusive. In pure-line breeding small individual differences between plants have been selected out and have maintained themselves for successive generations, and it is at least to be tested whether similar pure lines may not be obtained from a single individual.

I have material at hand, and I hope at some later time to be able to report on these questions.